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Illumination—Some of its Modern Aspects.

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[Communicated by the Author.]

In the field of illumination for public and domestic purposes, the direction of invention has been for some time confined, not so much to the problem of creating new systems, as to the improvement of those already extant. Indeed, to one who fully appreciates the comprehensive advantages which coal-gas possesses for illuminating purposes, both æsthetically and sanitarily considered, and the elaborate conveniences which have been devised and so universally introduced, to render the details of its distribution and consumption perfectly automatic, while at the same time perfectly under control, the difficulties to be overcome by an innovator upon a field so thoroughly cultivated, will be comprehended.

Financial considerations, however, preclude the establishment of gas works in locations other than large cities and towns—and for the benefit of those who are deprived of the luxury of coal-gas, inventors have most zealously striven. The development of the petroleum industry afforded a most effective spur to inventive genius, and has called forth a multitude of plans and processes for accomplishing this very necessary object. Of some of these it is the object of the writer, in the course of this article, to discuss the merits, as well as their bearing upon the score of safety. The composition and character of the petroleum oils are noteworthy, and the writer may hope to be pardoned for dwelling perhaps at too great length upon this point, since, otherwise, those of his readers who may not be conversant with the subject, will fail to comprehend the accuracy of any inferences which may be based upon them.

They are all of them composed of the elements carbon and hydrogen, and range, by imperceptible steps, from oils which are exceedingly light and inflammable, to those which are heavy, thick and viscous, and which can only be ignited at an elevated temperature. Nor is the material obtained from a certain locality to be regarded as a simple oil, since it is invariably a mixture of readily and difficultly inflammable oils. There is, of course, much difference in the appearance of the materials obtained from different locations—a fact most palpably manifested in their difference in gravity—but their general character is the same, whether found upon the shores of the Caspian sea or in Pennsylvania. So numerous are the constituents of these oils, so closely do they resemble each other in their physical and chemical properties, that their separation and identification has afforded a problem which the skill of the chemist has thus far been baffled to solve; and the sum of our knowledge of them may be contained in the statement, that they consist of mechanical mixture of a great number of miscible hydrocarbons, whose gravities and boiling points increase by such imperceptible gradations that it is impossible to separate them, except roughly. For convenience sake, a number of commercial distinctions have been made, to which there is, at the present time, no valid reason to object. Of these, those which are known familiarly under the names burning oil or petroleum, benzine, and gasoline, alone concern the purpose of this paper.

It must be noticed that, though in general character these compounds are almost identical, yet, when considered in relation to their adaptability as illuminants, a marked distinction can be made.

The petroleum oil boils at an elevated temperature, and at the ordinary temperature throws off only an inappreciable quantity of vapor. A lighted match, approached to an open vessel containing it, will not ignite it, and if plunged into the oil, it will be extinguished. With the other members of the series, however, the boiling point is but a trifle removed from the ordinary temperature; and at the ordinary warmth of our dwellings, they are constantly throwing off volumes of vapor (the gasoline, of course, to a much greater extent than the benzine). A lighted match approached to an open vessel of either of them, will ignite them at once, and at some distance from the surface of the material. The experiment is not one which can be recommended for repetition, for though instructive. it is by no means free from danger.

It appears, therefore, that the light oils, owing to their extreme volatility, cannot be handled with the same indifference as the heavy ones. An open vessel, containing either of them, placed at some distance from the neighborhood of a flame, may, more likely than not, be the cause of sad mischief, and from a very simple cause. The vapor which it is constantly and imperceptibly giving off, flows from it in all directions, seeking the floor, in virtue of its superior density to the air—and once in contact with the flame, a flash, and the ignition darts, in an instant, back to its source.

Of the invidious, imperceptible nature of the dangers attendant upon their employment as illuminants, the public cannot be too clearly conscious, or too forcibly warned. And under no circumstances, is the employment of these incendiary materials so severely to be condemned, as in the portable lamp so generally employed in the household. There are, it is true, circumstances under which they may be, with certain precautions, employed for other purposes than as lighting agents—and of these the writer will have occasion to speak, further on—but in the portable lamp, they may at any moment add another to the list of terrible accidents with which the public is already too familiar. Let the attention be but for a moment directed to the state of things involved. The body of the lamp is invariably of glass, and hence fragile. It is supposed to contain some of one of the lighter oils, the peculiar properties of which have just been alluded to. In the process of burning, the metallic attachments of the lamp will communicate sufficient heat to the body of the oil within to fill the whole of the space above the oil with its vapor. So long, now, as the lamp remains unbroken, and its attachments without leakage, this circumstance is of little consequence, and, of itself, the confined vapor cannot be made to explode or ignite. But suppose the lamp, in this condition of things, to be shattered by a fall, a circumstance by no means infrequent—the consequence will inevitably be, that the inflammable vapor in the neighborhood of the flame would at once ignite, and with it, the whole body of oil in the lamp, to the imminent peril of person and property. Or suppose the equally probable circumstance, that the lamp, as before, should be refilled while burning, when the result might be, if possible, more disastrous than in the preceding case; for the volatile and inflammable vapors filling the upper portion of the lamp would inevitably, by their rapid diffusion into the air immediately surrounding the flame, form an explosive mixture, from the effect of which the lamp and its burning contents would be scattered in all directions. Where the oil made use of is one of proper quality, neither of the accidents here hypothetically stated would be possible, since, in no case, with a properly constructed lamp, could there be generated within the body of the lamp an amount of vapor sufficient to cause an explosion; nor could the oil itself be ignited at so moderate a temperature.

It is simply to be set down to good fortune, if one who has employed these oils for household purposes has escaped scot free, since no amount of care can avail against the inevitable result which must follow one accident. It is readily understood how persons ignorant of the highly dangerous character of the light petroleums, may unknowingly make use of them in the manner above named; but it is really a matter of concern and surprise, that so many, even of those who are thoroughly aware of the nature of the incendiary they are introducing into their households, are, nevertheless, thoughtless or indifferent enough to continue the suicidal practice—for no term can be too strong to properly characterize the fearful nature of the risk one is constantly running while employing these oils in portable lamps.

There is, unfortunately, such a thing as too much legislation, as most communities are unpleasantly aware, but it would almost seem there can well be no grounds for such a complaint on a subject which so intimately concerns the safety of the individual and the general public, as just this one. There are, it is true, laws which are intended to regulate the sale of this material, an inspection of its quality, and severe penalties, on paper, designed to punish those who sell, for illuminating purposes, an oil which will inflame below a temperature fixed by law at 110° Fah. But, most unfortunately, the legislation on the sub-

ject utterly fails to accomplish the end for which it was intended, namely, to protect the great body of the people, who are not supposed to be familiar with the nature of these materials, from the possibility of unknowingly running into such dangers as those which the writer has endeavored to make clear in what has preceded.

The inspection is made by the officer who is officially charged with this duty, *before* the oil is sold to the dealer who supplies the public at retail, and not *after* it has left the hands of the wholesale dealer. And in this lies the feature which renders the legislation on this most vital subject, as far as its efficiency in protecting the public is concerned, practically useless. A few words will suffice to make the point evident. The oils which are caught from the wells are submitted, before they are separated, by fractional distillation, into the several commercial articles already named. Of these products, a very considerable proportion (about 15 per cent.) consists of the benzine or naphtha, and for this the demand in the various industrial arts is by no means equal to the supply; in consequence of which it commands but an inferior price in the market, in fact, considerably below that demanded for the burning oils proper. Here, then, exists a direct temptation to dishonest or ignorant dealers to adulterate their stock of burning oil with oils of inferior price and dangerous quality. To what extent this reckless practice is carried on, the thinking portion of the community have no just conception, but the writer feels safe in asserting that it is as general as any of the trade adulterations. The assertion is based upon the results of a large number of examinations into the character of oils from various portions of Philadelphia, sold to the public as burning oils; an examination which revealed the startling fact that, of a great number of samples thus tested, scarcely five per cent. of the whole number passed the ordeal of the fire test. In other words, the oils were, with the very few exceptions indicated above, simply burning oils, more or less liberally adulterated with benzine. How far these facts will go to explain the too often repeated instances of "coal oil horrors," the intelligent reader will be able to judge for himself. And it is certainly a melancholy species of consolation to know that what has been here shown to be true of Philadelphia, is true, though perhaps not to such an exaggerated extent, of other large cities and towns. As an indication of the condition of things existing elsewhere, the writer would refer to the recently published annual report of the fire inspector of another city, in which attention is called, in the most earnest terms, to the unusually large proportion of fires, accompanied, at times, with loss of life, during the year just passed, which were ascribed to petroleum; tracing them directly to an utter disregard for and inadequacy of the laws designed to protect the public against the danger of employing the light oils in portable lamps.

In view, therefore, of the facts here set forth, there would seem to be but one remedy available to the thinking portion of the community, namely, to urge the legislative bodies, with all the earnestness which the gravity of the existing condition of the subject demands, to make, with the least possible delay, such amendments to the laws regulating the sale and inspection of the petroleum oils, as shall render inspection a reality instead of a farce, and which shall punish with a severity commensurate with the gravity of the offence, any violation of them, whether committed through ignorance or intention. The remedy here suggested could simply be reached by a judicious modification of the existing laws; and their vigorous enforcement would prove an effectual barrier to the sale of the adulterated stuff, which now provides almost every household with a treacherous, insidious enemy.

[To be concluded.]

New York burns about 1,200,000,000 cubic feet of gas per annum; Chicago, 400,000,000; St. Louis, 250,000,000; Cincinnati, 400,000,000; Pittsburgh, 200,000,000; San Francisco, 250,000,000, and Baltimore, 400,000,000.

Chemical Repertory.

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EDITOR—HENRY WURTZ.

CHEMICAL EXCERPTS.

664. **Automatic Fire-Alarm.**—A correspondent, F. I. R. E., suggests a system of small tubes throughout a building, with small chambers full of some volatile liquid (such as alcohol, bisulphide o carbon, etc.) attached thereto at intervals. One end of each tube should be closed, and the other should terminate in a cylinder and piston arrangement, the motion of the piston being used to ring a bell. A similar result might be obtained by using an explosive compound in the chambers.

Another plan is to stretch electric wires of fusible metal through the premises, the melting of the wires serving to break the circuit and give an alarm.—*Sci. Am.*

665. Phosphorescence of Orris Root.—X. Landerer has observed this phenomenon repeatedly on digging at night the rhizome of Iris florentina; it occurred in the form of luminous spots.

666. Process for Purifying the Condensation of Engines from Fatty Matter.—The steam condensing from engines always contains fat, resulting from the material used for lubricating. Cail & Co., in Paris, collect the water of condensation in a common reservoir, and pump it into a receptacle provided with a powerful stirring apparatus, consisting of shovels, Archimedean screw, etc. This receptacle is three-fourths full, the remaining space being filled with petroleum; the apparatus is set in motion for five minutes, the water being allowed to settle for fifty-five minutes. Five minutes' time is sufficient to separate all the fat which is then contained in the oil, and the purified water can be directly used again. A hundred pounds of petroleum will absorb fifty pounds of fat; it has then a specific gravity of 0·840, but should be renewed when presenting a density of 0·810. It is regained by distillation.—*Sci. Am.*

667. Method of Purification of Rosolic Acid.—Ch. Girard.—In the introduction to this paper the author gives a *resume* of the methods by which pure phenol or cresylol may be converted into rosolic acid, while, further, the experiments of Wanklyn and Caro with rosaniline, and those of Liebermann with the same substance (the final result in each case being the formation of rosolic acid) are spoken of. The author next describes at length a rather complex process of purifying the rosolic acid obtained from either rosaniline or any of its salts by the aid of water under high pressure at 205°. The substances resulting from this reaction are first treated by the author with aniline, neat being applied. Thus there is formed azuline blue, which is first treated with hydrochloric acid, then washed with water, dried and reduced to powder; this is treated with caustic potassa. The insoluble residue is again treated with dilute hydrochloric acid, then washed with distilled water, and having been dried, the residue is treated with the vapors of either chloroform or crystalline benzine; again dried, treated with alcohol, filtered, and the solution evaporated. The residue is treated, under pressure at 100°, with alcoholic potassa solution, whereby aniline is formed (from the triphenylic-rosanline present in the matter) and rosolate of potassa, which, after the addition of water, is decomposed by an acid, yields flocculent rosolic acid. This is further purified, after washing and drying, by solution in boiling absolute alcohol; from the hot filtrate of that solution the pure rosolic acid is deposited on cooling in a crystalline state.—*Chem. News.*

668. Accidental Explosions.—A correspondent of the New York *Evening Post* gives the following explanation of how accidents may happen:

"Let us suppose the reservoir of one of these stoves to be fully charged and the coal issuing from the base thereof to be ignited. The incandescent mass throws off large volumes of carbonic acid gas, which, passing through the layer of highly heated coal above it, loses a portion of its oxygen and becomes an inflammable and explosive gas, known to chemists as carbonic oxide. The gas rises through the reservoir to the top, and, having no means of escape, is confined there. This process continues so long as the supply of coal lasts, and finally, when the reservoir is emptied and the burning mass of coal has sunk below the lower edge of the reservoir, we have a large confined volume of inflammable gas brought into contact at the same time with the oxygen of the air and a mass of red hot coal. The result may be a violent, but not a loud explosion. The red hot coals lying under the mouth of the reservoir are thrown with great force through the thin mica windows of the stove and strewn over the carpet and woodwork of the room. The noise of the explosion is so slight and so much smothered by the fact that it takes place in the interior of the stove, that a person living in the next room might not hear it."

669. A French Chemist has discovered that a strong solution of chloride of zinc will dissolve all the silk threads from any textile fabric, leaving intact any cotton fibres which may be interwoven therewith. The practical value of this invention for removing stains from dresses must be at once apparent to all our lady readers.—*World.*

670. Dessiccation of Egg Albumen.—Stan. Martin recommends the following as the most expeditious method: in an airy room, well protected from dust, a square frame is placed upon two chairs or suspended by cord, and a piece of muslin or linen stretched over it, on which a layer of egg albumen is spread. When this is dry, a second, third, and even fourth layer is spread on, until scales several millimeters in thickness are obtained. In drying, the albumen detaches itself from the fabric, and to hasten the desiccation, the whole may be exposed to the sun under a cover of unglazed black material.—*Am. Journal of Pharmacy.*

671. Harness Dressing.—Long continued observations show that harness and other leather, exposed to the action of ammonia continually given off in stables, becomes weak and rotten sooner than other leather. Even when care is taken to protect it with grease, this takes place. Professor Artus recommends the addition of a small quantity of glycerine to the oil or fat employed in greasing such kind of leather, asserting that it keeps it always pliable and soft.—*Sci. Am.*

672. Action of Potassium Upon Benzole.—H. Abeljanz.—By heating absolutely pure and anhydrous benzole in a sealed tube with potassium to from 240° to 250°, a combination by addition of the two bodies, is obtained; benzole potassium in a dry state, is a very explosive compound, which is also violently decomposed by water; when this decomposition takes place more slowly, under a layer of benzole the result is the formation of diphenyle. The napthaline potassium is violently acted upon by bromide of ethyle; among the products of this reaction is a hydrocarbon, $C_{20}H_{12}$.—*Ger. Chem. Soc.*

673. Iodal $C_4 HI_3 O_2$, discovered by Aime more than thirty years ago, which is obtained by acting upon iodine with a mixture of absolute alcohol and concentrated nitric acid, is recommended by Guyot as an excellent anæsthetic, in doses of one to two and a half grams. It is a colorless oily liquid, resembling chloral in odor; boils at 25° C., and is decomposed by alkalies into iodoform and formic acid.—*American Jour. Pharm.*

674. Observations on Silicic Acid.—Rammels-

berg.—The main gist of the first part of this paper is that the amorphous silicic acid, as frequently obtained in analysis, is only soluble after ignition, which renders it anhydrous in a boiling concentrated solution of carbonate of soda, or of potassa when the ignition was comparatively gentle; because, at a rather high temperature, although far below that of the porcelain-kilns, amorphous silica is converted, either wholly or in part, into the crystalline state (tridymite), and its specific gravity is then 2·3. Some other amorphous bodies, berylla, titanic, zirconic, niobic, and tantalic acids, for instance, are similarly converted into crystalline bodies. In the second portion of this paper, the author observes that the quantity of water contained in silica, precipitated from alkaline silicates by acids, and dried, either over strong sulphuric acid or at 100°, varies, so as to exhibit hydrates of the formula $nSiO_2 + aq$, the value of n being in this case equal to from 4 to 8. Air-dried silica, even when apparently quite dry, may contain from 13 to 36 per cent. of water.—*Germ. Chem. Soc.*

675. FIRE.—In case of a fire stretching suddenly across Manhattan Island, and then sweeping rapidly toward the Battery, what would become of the people south of where the conflagration originated? Where would they go? How would they get away? Could a sufficient number of steam-boats approach near enough to such a fire to rescue them all? If not, the tragedy of the Fifth avenue Hotel, fearful as it was, would be but a feeble illustration of a spectacle which the most distant parts of the civilized world would not cease for centuries to remember with horror.—*N. Y. World.*

676. CROTON WATER.—Commissioner Van Nort, of the Department of Public Works, reports that the valves have been placed in the gates of the new storage reservoir at Boyd's Corners, on the Croton River, and that reservoir is being rapidly filled, the water having reached at noon of February 15th, a depth of thirty feet. The reservoir will contain, when filled, 3,000,000,000 gallons, or nearly double the capacity of all the reservoirs now in use. This will greatly reduce the dangers of water famine in the future.—*Ibid.*

Bad Ventilation in the Mont Cenis Tunnel.

When the Mont Cenis Tunnel was opened, some doubts were entertained by competent people that the natural ventilation of the tunnel would be sufficient under all circumstances. Though these doubts were soon dispersed in consequence of the practical working of the Mont Cenis line, they have had, as it now seems, a very good foundation. The *Bund*, of Berne, of December 12th, contains a correspondence from Turin, of the 9th inst., of the following tenor. In the first week of December, a goods train coming from Modane stuck fast in the midst of the tunnel, because all the personnel of the train had fainted in consequence of the vicious air and the smoke from the engines, which filled the tunnel. This train was met by another goods train coming from Bardonneche, which, however, had previously been cautioned by a railway guard who had gone on to meet it, but in doing so was caught by the train and so much injured, that he died afterwards. The Bardonneche train, however, succeeded in stopping in time, and in pulling out the first train, when the half-suffocated persons soon recovered their senses in the fresh air. A similar accident had happened a few days previously, when all the employees f the train had fainted, with the exception of the engine driver, who succeeded in pulling his train through.

Now, if such accidents have overtaken goods trains, there is no reason why passenger trains should be exempt from them under all circumstances, and the picture presents itself of a crowded passenger train, sticking fast in the tunnel, and all its inmates being gradually suffocated without any chance of rescue! The theory of natural ventilation of the tunnel was based upon the supposition that there was constantly a different temperature on either side of the Alps, that consequently the heavier cold air would flow through the tunnel to the warmer side of the mountain. In the latter part of the autumn, however, very frequent and violent barometrical disturbances took place all over Central Europe, and it is highly probable that the steady current of air through the tunnel was more than once brought to a standstill, and was even reversed. In that case the same column of foul air was oscillating between both ends of the tunnel without having a chance of being renewed, a fact which may be observed in any self-ventilating mine during the atmospheric changes in early spring and late autumn. The above-mentioned accidents give a timely warning of what may happen to unfortunate passengers in the Mont Cenis Tunnel, if no proper care is taken by the managers of the line to ventilate it mechanically, if need be; and they point to the enormous responsibility of those who, in their supreme ignorance, despise the warning.—*Engineering and Mining Journal.*

Gas and Peat as Fuel for Locomotives.

This somewhat antiquated subject is again discussed by foreign journals, Mons. Paul Carpentier having proposed to drive locomotives for a railway in the interior of Paris, by gas. This proposal naturally attracts the attention of engineers, and although the proposition is not new, we have learned the lesson that many things considered impracticable in the past are destined to become features of engineering in the future.

The use of gas for locomotives passing over city tramways, has many advantages over that of any fuel hitherto proposed for that purpose. In the first place it is, under easily attained conditions, entirely combustible, making neither ashes nor smoke. Being lighter than atmospheric air, its transportation is limited to the cost of carrying the vessels which contain it. It may be so regulated as to require no attention whatever from the driver of the engine. It may be made to generate heat with greater economy in its application to steam production, in proportion to the amount consumed, than any other known fuel. Its cost in European cities is not so much greater than coal, in proportion to the amount of heat obtainable from it, as to neutralize the advantages named. It may be lighted or extinguished instantaneously; therefore there is no waste of fuel in the commencement or termination of fires. When locomotives are standing, the gas therefrom may be so regulated as to impart to the boiler barely the amount of heat necessary to maintain the requisite steam pressure. It requires no grate; therefore, the appliances for generating steam could be made more compact than they could be for the use of any other fuel.

As compared with peat, which has also been proposed for this purpose, the cost of gas is greater, but in our opinion, it has many advantages over peat, the latter fuel being open to all the objections that can be brought against coal as fuel, with the single exception, that the combustion of a given weight will probably generate more units of heat than the coal in common use for locomotive purposes in this country. Mons. Carpentier's plan involves the use of a tank which takes the place of the ordinary tender to locomotives, and in which is stored the gas to be used as fuel. This receptacle runs on a track like the ordinary tender, and from it the gas is pumped to supply the locomotive. The locomotive has nothing peculiar in its construction, except the gas furnace.

It is questionable whether at the high rates charged for gas in this country, the plan would be feasible here, considered solely with reference to profit, and of course this consideration cannot be overlooked, no matter how practicable the use of gas might be in other respects. This difficulty might be overcome by the combination of the principal tramway lines in any large city, to manufacture the gas necessary for the purpose, in which manufacture, they could save the enormous profits now realized by existing gas companies, and also the expense of purification, as it is heat rather than illuminating power they would seek to secure.—*American Artisan.*

Coal—Death in the Mines.

The *Scranton Republican* gives some statistics relating to the Eastern District of Luzerne county. This district comprises all the mines south of Wilkesbarre and east of the Susquehanna river, being ninety-five in all. The total production of coal in the district was 6,560,450 tons, or very nearly one-third of the entire anthracite production for the year 1872. The *Republican* in its article says:

We do not propose to discuss the production of this magnificent coal field, but to refer to the annual death roll that is before us. We have now the complete statistics of casualties in the mines during the past year, in Schuylkill, Northumberland, Dauphin, Columbia, and the Eastern District of Luzerne counties. The only district from which we have no report is that comprising the lower part of Luzerne and the whole of Carbon counties. There is some satisfaction in the fact, that the lists of the dead and injured, and the widows and orphans, are not so large as they have been in former years, but they are nevertheless very great. We append the list for the anthracite regions, with the exceptions above noted:

	Killed.	Injured.	Widows.	Orph'n.
Schuylkill	71	126	41	139
E. D. Luzerne	67	187	38	119
Northumberland	8	26	3	14
Columbia	0	10	0	0
Dauphin	7	13	2	11
Total	153	462	84	283

The proportion of dead and injured, according to the amount of coal produced, is greatest in Schuylkill county. The proportion is as follows:

In Schuylkill county there was one person killed for every 74,000 tons of coal mined; in the Eastern District of Luzerne, one for every 97,947 tons; in Northumberland, one for every 200,000 tons; and in Dauphin, one for every 76,000 tons. The seven or eight mines in Columbia county seem to be worked with extraordinary care, for no one working in or about them has been killed during the past two years, ond only ten injured.

The report of casualties published elsewhere, seems to indicate that the mine ventilation law has been bearing good fruits during the year. Only three men lost their lives by explosions of fire-damp in the 95 mines in the district. This is a great improvement on the sad records of casualties of former years. The falling of coal and rock is the cause of a great proportion of the deaths and maiming in the mines. Of the 153 killed, as above enumerated, not less than 70 were crushed beneath falling coal and rock, and 140 of the injured received their injuries from the same cause. From the lists of the casualties in the mines in Schuylkill, it would seem that the mines are either more dangerous on account of fire-damp than those in this district, or else the ventilation is not so good there as here. In the mining of 5,000,000 tons of coal mined in Schuylkill county, 17 men were killed and 91 injured by the explosion of gas; in the Eastern District of Luzerne over 6,500,000 tons were mined, and only three men killed and twenty-three injured by gas explosions. This fact speaks well for the operators, and especially for the Mine Inspector of this district, Mr. Patrick Blewitt. It is evident that more care is being manifested than formerly, to enforce the provisions of the mine ventilation law.—*U. S. Railroad and Mining Register.*

The Boston Fire Commissioners' Report.

The Commissioners appointed by the city authorities of Boston to make investigations into the cause, effects, etc., of the great fire have recently published quite a voluminous report. Seven hundred and seventy-six buildings, covering a space of sixty-five acres and assessed at the value of $13,500,000, were destroyed, together with more than $60,000,000 worth

of merchandise and other personal property. How the fire first broke out is not definitely stated, but its rapid spread in the building first consumed is considered to be chiefly owing to the faulty construction of the elevator which, like most elevators in Boston, was sheathed with wood and destitute of self-closing hatchways. The committee state that, if the last mentioned appliances had been in the edifice, the flames would not have reached the roof before the engines arrived, and the calamity might have been averted.

There seems to have been considerable delay for want of horses and a lack of water. The fire, it is also stated, was greatly aggravated by the escape of gas from the burning buildings, the water valves, which were believed to be sufficiently powerful to cut off the supply, proving of little value. Sliding valves should always be so arranged, that the risk arising from the impossibility of isolating a burning district should never be incurred. The report strongly condemns the action of the authorities in allowing the use of gunpowder for blowing up buildings by citizens or others, not regular officials of the fire department. Recommendation is made that a system be arranged, for the future, for using a far more powerful and less dangerous explosive, and for training a number of men to use it skillfully. Dynamite is considered as the best material for the purpose, as its force is so directed as to bring the building down rather than scatter it in fragments. It may be dropped or taken in any way without danger, and cartridges containing it may be safely cut or broken. A quantity of this substance should be kept constantly in proper places.

The Lowry hydrant is recommended for use throughout the city as giving a better distribution of water. Fire escapes should be attached to all warehouses, and every high building should have a permanent stand pipe of iron capable of having a hose attached to it. Finally, the general use of the most approved forms of fire extinguishers and hand pumps in every house is strongly urged. These would prevent many conflagrations from becoming serious, and they would inspire confidence in cases of alarm of fire.—*Scientific American.*

Combined Water in Fuel.

Disputes are continually arising about the amount of water in different fuels, particularly lignite and peat It is not difficult to determine the amount of *moisture*; and this is frequently assumed to be the whole amount of water. But when analyses are to be treated as evidence of the heating power of fuels, it is not sufficient to determine only the water which is driven off at low temperatures, at, or a little above, the boiling-point. The water in chemical combination must be determined also This is expelled by distillation, along with the hydrocarbons, and is often classed as "volatile matter."

It is true that we cannot prove the existence of this so-called combined water *as water* in the fuel. There is analogy and strong probability for supposing this to be the case, but all that we positively know is, that certain substances, such as wood, peat, and lignite, *contain combined oxygen;* and after determining the amount of this oxygen, we set apart the due proportion of hydrogen to satisfy it, presuming that this is the element combined with it. The rest of the hydrogen is considered as combined with the carbon of the volatile matter.

In the practical estimation of the value of fuels, this theoretical question makes comparatively little difference. The important point is that there is oxygen combined with a part of the fuel; or, in other words, a part of the fuel *has been burned already*, and therefore just so much has been taken from the heating power of the whole. This "combined water" must moreover be volatilized at the expense of heat obtained from the rest of the fuel.

Analyses which do not take into account the amount of oxygen in the "volatile matter" are worthless for comparisons of the heating power of fuels. They show the amount of fixed carbon, and of impurities in the ash; but in their vague category of volatile matter there lurks an unknown quantity of an incombustible of which they take no note.

Now, in this respect, as we said the other day of peat, the lignitic fuels are just where they always were. The improvements made in the preparation of peat affect the cheapness of its production, its physical purity and texture, and to some extent its hygroscopic water; but they do not touch the chemically combined oxygen. Properly prepared peat-charcoal, it is true, presents an entirely different case—and one to which we have made no allusion. It is not involved in the recent controversy on peat any more than charcoal is involved in the question of wood as a fuel.

We recommend the foregoing elementary lesson to the attention of a contemporary, which, with more zeal than knowledge, defends peat against our slanders because it is "coal in embryo." It is scarcely necessary to say that we have no quarrel with this embryonic logic. One does not carry on discussions with babes unborn. As far as our critic's enlightenment is concerned, we must patiently wait for that until his eyes are open. When that time arrives he will find the simple object-lesson we have furnished him, an excellent means of training his vision.

For our own sake, we wish to point out that our use of the term *fraudulent*, has been misrepresented. We alluded to "fraudulent comparisons between peat and bituminous coal," and this expression has been applied to the chemists who made the analyses. But it is not the *analyses* but the *comparisons* which are fraudulent. That same contemporary which objects to our use of the term "fraudulent" gives the following comparison:

"Here is an analysis of old Wemyss cannel coal under the manipulation of G. F. Cusier, F.B.S.S.A., Laboratory Dalkeith gas-works, Scotland.

Volatile matters	47·13	per cent.
Fixed carbon	35·31	"
Ashes	15·40	"
Sulphur	·84	"
Water	1·32	"
	100·00	

The sample of peat taken from Mr. A. Kennedy's bog at White Plains, Westchester Co., and analyzed by Francis E. Englehardt, Ph. D., St. Francis Xavier College, New York city, gave

Bituminous matter	48·59	per cent.
Carbon	39·50	"
Ashes	11·83	"
	99·92	

We are unable to see that this comparison is anything but fraudulent, unless the writer chooses to confess ignorance, That peat always contains water may be proved from every book on the subject we have ever seen, and we dare to say that no respectable writer has claimed to know of a peat which is free from water. The amount is usually given at 10 to 30 per cent., and yet we have here an analysis of coal in which 1½ per cent. of water is mentioned, while the 10, 20, or 30 per cent., which the peat must have contained, is entirely suppressed. We suppose the peat analysis is a theoretical one, the proportions of carbon, ash, and volatile matters having been calculated after deducting the water. This is a common proceeding of chemists who wish to allow the relative proportion of the elements in fuel. The name *peat substance* has been given to that compound of carbon, hydrogen and oxygen, which remains when both the moisture and the ash have been eliminated; and Scheerer puts the average composition of this substance at c. 60·63, h. 6·04, and o. 33 32, or c. 60·63 free, h. 2, and chemically combined water 38. But we are not dealing with the mythical peat substance, and to compare a theoretical analysis with one that is real, is certainly anything but just.

Again, as to the "bituminous matter." According to the commonly received analyses of fuels—those, for instance, given in Prof. Egleston's Metallurgical Tables, and which may be found in many standard works—peat contains on an average, about 33·4 per cent. of oxygen, the Ten Yard coal of Staffordshire 16·6 per cent., and Pennsylvania anthracite 1·7 per cent. There is, therefore, the greatest difference in the composition of the "volatile matters" of peat and of coal. But in this comparison there is no hint of this difference. The "bituminous matter" of peat is checked off against the "volatile matters" of coal, as if they were of equal value. Indeed, if there is anything in nomenclature, the peat is made to appear the more valuable. In fact, the author of that comparison, in placing the analysis of one class of fuel side by side with that of another and entirely different class of fuel, must have misled those of his readers who are uninformed on the subject, and can only have aroused the suspicions of those who do understand it. —*Eng. and Mining Jour.*

Supply of Gas for Nashville.

The stockholders of the Nashville Gas-Light Company held a meeting yesterday, at which they re-elected the old Board of Directors, Samuel Watkins, Samuel Pritchett, Daniel F. Carter, W. F. Cooper, John M. Lea, John Browne, and Jas. H. Kendrick.

The total quantity of gas manufactured by the company during the past year was 40,000,000, an increase of about 5,000,000 feet over the year previous. Of this quantity, 6,000,000 feet was used by the corporation, and 30,000,000 by private consumers, leaving a wastage of 4,000,000 feet, caused by leakage and condensation. The gas is sold to private consumers and citizens at the rate of $3.15 net per 1,000 cubic feet, and to the city at just half that rate. The total gross income of the company during the year for sale of gas, coke, and coal-tar, was $120,000. The quantity of coal burned was 180,000 bushels. The company uses Pittsburgh coal. We are told that it purchases its coal at that place manifestly for several reasons. If it purchased it from mines contiguous to Nashville, it would not only have the effect to produce a coal famine here, but would consequently raise the price of coal, which advance it, as well as the consumers, would necessarily be compelled to pay. By obtaining it from Pittsburgh the price of coal is equalized, and hence coal is sent here from that place as cheaply, by contract, as from the mines on our railroads. The company recently purchased $30,000 worth of Pittsburgh coal.

There are now 417 street lamps in the city and 1,800 private consumers, the latter paying to the company an average of $60 per annum each. The capital stock of the company in 1872 was $400,000; its taxes, State, county, municipal and railroad, was $12,000, and strange as it may seem to many, the city actually received more taxes from the company in that year, than it paid the company for gas, as we are informed,

The company has presented a proposition to the Edgefield Board of Aldermen, to run a mile of main pipe each year for two years, along the principal thoroughfares, and to sell gas to the Edgefield corporation and the citizens of the town, at same rates as are charged to the corporation and citizens of Nashville; the corporation of Edgefield being required only to erect gas posts, as is done in this city. Should the pipe be carried across the river by way of the suspension bridge, it would cost the company about $3,000, and if by the way of the bed of the river, it would cost from $12,000 to $15,000.

Rights of Established Gas Companies.

DECREE OF SPECIAL CHANCELLOR FINNIE OF THE FIRST CHANCERY COUET.

The Memphis Gas-Light Company vs. the Memphis Gayoso Gas-Light Company.—Last Monday special Chancellor John G. Finnie delivered an elaborate decree in the above case. The points decided are as follows:

After citing a large number of authorities, and dwelling at length on the proof in the cause, the Chancellor concluded with the following propositions; which he regarded as being fully established:

First—That it is impossible for complainant and

defendant to occupy the same streets with their respective gas mains located upon the same plane.

Second—That it is impracticable for defendant to locate its mains and pipes in the same streets above complainants mains and pipes without great damage to complainant.

Third—That it is impracticable for complainant and defendant to occupy the same streets with their mains and pipes with equal facilities for supplying gas to consumers, and that attempting to do so is an injury to both, but the greater injury to the company occupying the lower plane.

The proof further strongly tends to establish the following propositions:

First—That defendant's invasions, with its gas mains and pipes, of a street occupied by complainant, necessarily does injury and and mischief to the latter. To place them at any distance below complainant does the latter injury; to place them above does still greater injury, and to place them at the same depth is wholly impossible.

Second—That complainant cannot yield *equal* privilege of occupancy of a street to defendant, nor *similar* privileges *subordinate* to complainant's choice of location on the street, without impairing its own rights, embarassing itself in making changes of location, which may become necessary, and doing injury to its own mains and pipes.

In view of the above propositions the Court held that complainant has been damaged and injured by defendant, but inasmuch as complainant's rights to a perpetual injunction of the further manufacture and sale of gas by defendant is not shown by ample and satisfactory proof, the Court declines to grant such injunction now.

It is ordered that complainant may bring an action at law against defendant for all damages which it has suffered.

This case will be retained to await a verdict and judgment in such action the complainant shall recover, a perpetual injunction will then be granted; in the meantime, the preliminary injunction heretofore granted against defendant laying pipes above those of complainant will be continued.

It is ordered that until the decision of such action at law, or until a reasonable time has elapsed for the commencement and prosecution thereof to final judgment, the defendant is prohibited from laying any further gas mains or pipes in the streets which it does not now occupy, unless the defendant first gives bond in the sum of $100,000 for all such damages as the complainant has suffered or may suffer from the same.

Each party is left at liberty to hereafter apply to this Court for other or further relief, as the equity of their cause may demand, not inconsistent with the principles of this decree.

The Water Supply.

The special committee of the Common Council appointed to consider the question of utilizing salt water for the extinction of fires, and for use for sanitary purposes, held an adjourned meeting on Tuesday, 11th instant, in the committee room of the Board of Aldermen.

Chief Engineer Tracy, of the Croton Aqueduct Bureau, repeated his former statements, insisting that the Croton watershed can supply all the needs of the city by the laying of additional mains, etc. The Fire Department now are only short at high points, and not even there if sufficient pipes are laid. The Department is really deficient in large mains and that's all the trouble. If we have a dry season for six or eight months, and we want to prepare for it, all that is required is the building of more storage reservoirs. The watershed we've got is equal to any possible requirements. The plan of tapping the Hudson at Poughkeepsie is too expensive and is entirely unnecessary. As for supplying salt water, Mr. Tracy was very positive that for the same or less money Croton water could be supplied for every possible purpose. No pipes were wanted for salt water. The best way, if salt water must be had, is to have it pumped through hose by force pumps placed on the steamers and ferry boats on the East and North Rivers. The storage reservoirs have, he said, a capacity to hold 200,000,000 gallons more than we shall ever have need of. In 1870 the average daily supply of water into the city was 85,000,000 gallons; in 1871, 87,000,000; in 1872, 91,000,000. During January of this year the supply was 101,000,000 gallons; in February, 104,000,000 gallons daily; this increased consumption of water was owing to the extreme cold weather, people letting the water run to keep their pipes from freezing. The reason why our Fire Department find it difficult in some parts of the city to get water sufficient to quench a large fire is owing to the insufficiency of the mains. The Croton Aqueduct cannot supply to this city more than 104,000,000 gallons daily. If the city continues to increase in population at the present rate, an additional aqueduct will have to be built. Nothing short of an earthquake could do harm to the aqueduct. The new mains lately laid are made so that the water can be concentrated to one place.

Mr. James S. Hennessy, Fire Commissioner, gave it as his opinion that there was not a deficient water supply. He had not received any intimation, either officially or personally, that there has been a deficient supply or water at any time. In reply to questions of Alderman McCafferty, he said that there would be no difficulty as to the supply of water, if two very large fires were proceeding at the same time at each extremity of the city. It would not be possible for a fire in New York to assume so serious a character as that at Boston. The Fire Department of New York was in a very different condition to that of Boston, and the New York firemen went to work at a fire in quite a different way to the Boston firemen. He recommended the use of several large boats on the river, so that in case of fire the river water could be utilized. To a certain extent that was the case now, but the plan might be greatly extended with much benefit. He strongly opposed the use of salt water with the present fire machines. The machinery was of a very delicate character, and the salt would greatly deteriorate it.

Prof. Chandler, of Columbia College, and chemist to the Board of Health, said that he had paid considerable attention to the water supply of this city. He had great confidence in "the Croton," and thought it was amply sufficient, He had gone into figures in his investigations, and he gave the following as some of the results he had arrived at: The Croton water shed was 339 square miles. The rain fall averages 50 inches. The rain fall on 339 square miles amounted to 294,500,000 gallons. To bring it down to a more correct average, 806,000,000 gallons per day was the average amount of water received by the Croton shed. There was, however, much that was lost by evaporation; and what was not lost in that way came into the reservoir, and it would, therefore, be safe to say that there was for use an average of 403,000,000 gallons per day. The present reservoirs include the new one at Fifth avenue, that holds 20,000,000 gallons of water; the old reservoir, that holds 38,000,000; the reservoir in Central Park, that holds 1,000,000,000. That was a sufficiency for a supply of at least 10 days. The new reservoir at Boyd's Corner holds 3,369,000,000 gallons. Then there will be a supply for 33 days, with a very liberal supply; for a small supply there would be enough for about double that time. In view of these facts it was very advisable to make arrangements to store water to last us through the trying seasons. We had enough water on the water shed to supply all the water that would be required in this region, now or for time to come. But storage reservoirs were needful to keep this water supply available for New York. There was a little prejudice about using water that had received the drainings of large cities. He believed, however, that a running stream has a power of purification and the water purifies itself. He had had occasion to investigate this subject in the water supply to Albany. There was an objection to receiving the water from the river because it had received the drainage of Troy. There was, however, no necessity for any objection. The Croton water might contain twice the impurities it does and yet the water be very healthy. He was strongly impressed that $1 spent in increasing the supply of Croton was worth more than $10 spent in any other scheme. The salt water could be beneficially used for sanitary purposes—as cleaning the streets and for water closets. He was very strongly opposed to the use of water meters. It was as important to health to have no more restrictions upon the use of water than upon the use of air, and if water was charged by meter the effect would be to limit the use of it. There was a large class of our population who could not afford to pay for water if they knew that they paid for the quantity they used.

He knew that the effect of using water by meter for manufacturing purposes was driving manufactories away from the city. He knew of several instances of this. There was one case where it would have cost a manufactory $5000 per year for water in New York, and, therefore, they established their manufactory in the country. This fact was frequently taken into consideration, and was seriously damaging the interests of New York. He thought that the suggestion of Alderman McCafferty was a very good one, that, on leasing the ferries by the city, there should be a stipulation that each boat should be subject to the control of the Fire Department under certain contingencies.

The Committee then adjourned until Friday next, at 11 o'clock.

Tyndall on the Needs of American Science.

In a speech delivered in New York by Prof. Tyndall, on the eve of his departure for Europe, in referring to the needs of science in this country, said:

It would be a great thing, sir, for this land of incalculable destinies to supplement its achievements in the industrial arts by those higher investigations from which our mastery over nature and over industrial art has been derived, and which, when applied in a true catholic spirit to man himself, will assuredly render him healthier, stronger, purer, nobler than he now is. To no other country is the cultivation of science in its highest forms of more importance than to yours. In no other country would it exert a more benign and elevating influence. What, then, is to be done towards so desirable a consummation? Here, I think, you must take counsel of your leading scientific men; and they are not unlikely to recommend something of this kind. I think, as regards physical science, they are likely to assure you that it is not what I may call the statical elements of buildings that you require so much as the dynamical element of brains. Making use as far as possible of existing institutions, let chairs be founded, sufficiently but not luxuriantly endowed, which shall have original research for their main object and ambition. With such vital centers among you, all your establishments of education would feel their influence; without such centers even your primary instruction will never flourish as it ought. I would not, as a general rule, wholly sever tuition from investigation, but, as in the institution to which I belong, the one ought to be made subservient to the other. The Royal Institution gives lectures—indeed it lives in part by lectures, though mainly by the contributions of its members, and the bequests of its friends. But the main feature of its existence—a feature never lost sight of by its wise and honorable Board of Managers—is that it is a school of research and discovery. And, though a by-law gives them the power to do so, for the twenty years during which I have been there no manager or member of the Institution has ever interfered with my researches. It is this wise freedom, accompanied by a never-failing sympathy, extended to the great men who preceded me, that has given to the Royal Institution its imperishable renown.

I have said that I could not wholly sever tuition from investigation, and I should like to add one word to this remark. In your chairs of investigation let such work as that in which I have been lately engaged be reduced to a minimum Look jealously upon the man who is fond of wandering from his true vocation to appear on public platforms. The practice is absolutely destructive of original work of a high order,

Now and then the discoverer, when he has anything important to tell, may appear with benefit to himself and the world. But as a general rule he must leave the work of public lecturing to others. This may appear to you a poor return for the plaudits with which my own efforts have been received; but these efforts had a special aim. My first duty toward you, moreover, is to be true, and what I say here is the inexorable truth.

The Photometer Applied to Astronomy.

In a recent article on the physical nature of the planet Jupiter (see page 400 of of our volume XXVII), we described the important results deduced from photometric observations of that planet; and we may add to this that photometry has often been applied to the starry heavens, in order to determine the comparative luminosity of the heavenly bodies. It is evident, however, that the common methods as applied here on earth to compare the relative intensity of different flames, and of which one was described on page 83 of this volume, are entirely inapplicable; and therefore other modes must be applied, and photometers based on totally different principles must be resorted to.

The most perfect photometer adapted to measure and compare the light of the heavenly bodies is undoubtedly that invented by Zollner, the famous astronomer and spectrocopist of Berlin; he invented it as early as 1860, but only recently has he applied it extensively to celestial photometry. It is based on the principle of the polarization of light; and in order to accomplish his purpose, he makes use of the property of the analyzer (see Tyndall's lecture, page 35 of our current volume) to transmit or obstruct the polarized ray in proportion as it is turned round an arc of 90°; for intermediate portions of the angle of rotation, a strong light may be gradually diminished till the transmitted rays are equal to the weaker light.

The first thing Zollner had to do was to determine how far the angle would serve as a measure for the intensity of light. Mathematical theory teaches that the amount of light transmitted does not increase as the angles themselves, but as the squares of their sines. Zollner found this law perfectly verified by practical experiment, in testing this photometer in many different ways. By attaching such a polarizing photometer to an astronomical telescope, he has been enabled to determine the comparative luminosity of divers heavenly bodies with greater accuracy than had previously been possible; and the results obtained will especially be most interesting to posterity, who will be able to determine what changes have taken place in the course of time, changes which are sometimes very great and of the utmost importance to the extension of our knowledge of the nature of the heavenly bodies.

As a standard of comparison, he uses the light of a lamp shining through a pin-hole; and in order to be independent of the perhaps variable light of this lamp, which may differ on different nights, he compares two stars with the lamp, and only notices the difference between the stars. If, for instance, the planet Jupiter has to be compared with Venus, he directs the telescope to Jupiter and turns the analyzer till its luminosity is equal to that of the lamp shining through the pinhole, and finds it was turned, say, 10°; then he directs the telescope to Venus, and finds that he must turn it 25° in order to diminish its light till it is equal to the lamp-light. The relative luminosity will then be as the square of the sines of these angles, that is, as $0{\cdot}0174^2$ is to $0{\cdot}0389^2$, or as 0·00030276 is to 0·001-51321, or, approximately, as 3 to 15 or 1 to 5.

Among the results thus obtained by Zollner are the following:

COMPARISON OF PLANETS.

The fixed star *Capella* as compared to Mars is as 1 to 7; to Jupiter, as 1 to 10; to Venus, as 1 to 50; to Saturn, as 1 to 0·04; to Uranus, as 1 to 0·0066; to Neptune, as 1 to 0·0007.

COMPARISON OF FIXED STARS.

The same star *Capella* as compared to *Sirius* is as 1 to 5; to *Vega* as 1 to 1·2; to *Betelgeuse*, as 1 to 0·5; to *Regulus*, as 1 to 0·4; to *Polluz*, as 1 to 0·3

THE MOON COMPARED TO THE PLANETS.

The full moon as compared to Venus, when full, is as 150 to 1; to Jupiter, as 700 to 1; to Mars, as 1,000 to 1; to Saturn, as 18,000 to 1; to Uranus, as 1,159 000 to 1; to Neptune, as 10,000,000 to 1.

The sun as compared to the moon is as 700,000 to 1. Consequently the light of the sun surpasses that of the most distant planet, Neptune, 7,000,000,000,000 times.—*Sci. Am.*

Smoke Prevention.

[From "The Engineer."

The last number of the "Journal of the Royal United Service Institution" contains a very interesting paper "On the Economy of Fuel in Ships of War" by Mr. T. Symes Prideaux. Mr. Prideaux has for many years, as most of our readers are, no doubt, aware, labored energetically to secure efficient combustion in steam boiler furnaces; and although the paper we have just named does refer slightly to other points connected with the economy of fuel, it is mainly devoted to an investigation of the laws of combustion in steam boiler furnaces, and the means to be adopted in rendering combustion as complete as possible. The subject is one of infinite importance to every employer of steam power, and it is to be regretted that the "Journal of the Royal United Service Institution" is not so generally accessible as is to be desired. We shall endeavor to put Mr. Prideaux's propositions before our readers in as condensed a form as possible.

Mr. Prideaux, after a few general statements, proceeds to explain the laws of combustion. We have no exception to take to the manner in which he does this; still we think that the whole gist of this subject may be put into a somewhat more compact form than that which he has adopted. He refers, as is usual, to the atomic composition of gases, and speaks of volumes of oxygen, carbonic oxide, etc., in a way which, albeit quite satisfactory to the chemist—or, at least, to those possessing some chemical knowledge—does not appeal very directly to ordinary steam users. We shall put the facts in our own way.

When a pound of carbon is completely burned, it liberates 14,500 units of heat; in other words, 1 lb. of carbon so burned liberates heat enough to convert 15 lbs. of water into steam. In practice it is quite impossible to burn the 80 per cent. or so of carbon which coal contains, at one operation. When the furnace is charged with fresh cold fuel, that fuel will not burst into flame all at once—on the contrary, it undergoes a species of distillation. Ordinary coal may be regarded as containing 80 per cent. of carbon and 5 or 6 per cent. of hydrogen in chemical combination with the carbon, and at low temperatures—less than 800°—the hydrogen escapes in combination with carbon as carburetted hydrogen; but hydrogen at a high temperature unites with eight times its weight of oxygen; the result is, that the combustion of one lb. of hydrogen liberates about 60,000 heat units, or four times as much as a pound of carbon. Unless 8 lbs. at least of oxygen are supplied to each pound of hydrogen, the carburetted hydrogen gas does not burn at all, however high the temperature, but flies up the chimney with a resulting waste equal to about 15 per cent. of the whole fuel. Turning now to the carbon, we find that, if enough oxygen be supplied, that is to say $2\frac{2}{3}$ lbs., or 12 lbs. of air per pound of carbon, and if the temperature be sufficiently high, we have complete combination, the resulting product of combustion being $3\frac{2}{3}$ lbs. of carbonic acid, or, in modern chemical nomenclature, carbonic anhydrite. But this perfect combination can never be secured at once. A portion of carbon next the fire-bars unites at once with the required quantity of oxygen, and the resulting carbonic acid, in ascending through the green fuel above it, dissolves the carbon. The $3\frac{2}{3}$ lbs. of carbonic acid, resulting from the complete combustion of each pound of carbon next the grate-bars, dissolve another another pound of carbon, and become converted into carbonic oxide, sacraficing, in doing so, 5,700 units of heat. Each pound of carbonic oxide then represents 14,500 units of heat due to the pound of carbon dissolved, and 5,700 units of heat absorbed in effecting the solution, or 20,200 units of heat in all. To recover this we must supply each pound of carbonic oxide with $2\frac{2}{3}$ lbs. of oxygen when it burns with a blue flame and gives out all its heat. It will be seen from this that, by wasting the carburetted hydrogen and the carbonic oxide, we can sacrafice, in round numbers, about two-thirds of all the heat generated. In practice few furnaces are so badly constructed that this result always takes place; but it is also true that, under ordinary conditions, most furnaces send a great deal of carburetted hydrogen and carbonic oxide up the chimney. The remedy is, of course, to supply sufficient air: but from the very nature of the case it appears to be impossible to do this through the bars. The larger the supply through them the larger will be the quantity of carbonic acid produced per minute, and the greater the quantity of carbon dissolved and carried off, as carbonic oxide. Air must be admitted above the fire as well as through the bars, in order that a sufficient quantity of the *free* oxygen may be supplied to combine with the carbonic oxide and reduce it to carbonic acid. The late Mr. C. Wye Williams, and many others with him, held that it was proper to admit air continuously above the bars to secure complete combustion. In a certain sense Mr. Williams was right, but practically he was wrong; and although complete combustion may be effected with perforated doors, it is well-known to every engineer that, as a result of the free admission of air over the fire, the steaming powers of a boiler are reduced, although the economic efficiency of the fuel is to some extent increased. The reason is this:

The air admitted carries off heat with it which ought to go to the water, the temperature in the furnace and flues is reduced, and it is, indeed, quite possible to admit air enough to defeat the object in view, because the temperature of the gases may be so lowered thereby that they will not burn. The great demand for air above the bars occurs just after firing. In the first place, because it is only during the few minutes after firing that carburetted hydrogen is produced; and, in the second place because, just then the influx of air through the bars is reduced to a minimum in consequence of the increased thickness of the bed of fuel through which it has to force its way. After the fire has burned clear, we are done with the hydrogen, and as the fire thins, sufficient air will find its way through the bars to secure the combustion of most of the carbonic oxide. Under the best circumstances it is probable, however, that a considerable portion of this gas escapes unburned; but it is better to submit to this loss than to incur the far greater evil caused by admitting air freely at all times above the bars.

In all that we have just written we have expressed opinions with which Mr. Prideaux coincides, although we have placed the statement of facts in a different form from that adopted by him. We have now to explain how Mr. Prideaux applies his knowledge in practice. It is well-known that a great number of inventors have devised schemes for admitting air above the burning fuel for a limited period, varying, say, between 1 and 5 min. after firing. The great difficulty to be contended with is, the inherent roughness of the conditions under which stoking is effected. It will not do to leave the regulation of the air admission to the stoker, as has been abundantly proved in practice; nor can any delicate piece of automatic mechanism be trusted to remain in order for any time in the dust and heat of a stokehole. For about twenty years Mr. Prideaux has labored to produce some device which will get over these difficulties, and we think we can say, after a personal and careful examination of his apparatus, that he has been in the main successful. A portion of his paper in the "Journal of the Royal United Service Institution" is devoted to a description of this apparatus, which we shall illustrate in an early impression. Its principle may be very easily rendered intelligible, however, without drawings. To the inside of a fire-door is fitted a perforated false door. The space of a couple of inches between the two doors is closed at the bottom and two sides. The top is fitted with a light flap of thin iron. When this flap is raised air rushes down between the doors and through the perforations in the inner door into the furnace. When the flap is shut down do air can enter the furnace save between the fire-bars. The door is fitted with the simplest conceivable device, by which, whenever it is fully opened—as for firing—the flap is thrown up and air admitted. In order to retard the falling of the flap, a little mercury cataract is fixed on top of the door, and the time during which air is admitted is determined by the rate at which the mercury can escape from the under to the upper side of a cup.

As this cup fills, the air-admission flap sinks and cuts off the supply of air. There is nothing about the apparatus to get out of order, and we are unable to see how anything can be simpler or better suited to the object in view. The apparatus has been tried on a very large scale in the steamship Republic, with results of the most satisfactory character, as we have already stated.*

We must refer our readers for a detailed statement of the results he has obtained in other cases to Mr. Prideaux's paper. It will suffice to state here that we believe he has solved a difficult problem in a way, upon the whole, satisfactory. We know, by personal observation, that he has completely succeeded in preventing smoke under difficult circumstances, which is, perhaps, no remarkable feat: but he has done more than this, for he has succeeded in effecting a considerable saving in fuel as well without reducing the evaporative efficiency of the boiler. This is a point of very considerable importance, as we have shown. Mr. Prideaux has brought a thorough knowledge of his subject to bear in working out the details of his invention, and this is, no doubt, the reason why he has obtained satisfactory results from it.

* *Vide* "the *Engineer*" for October 11th and November 1st.

Effects of Hot Air Blasts.

Professor Akerman, of the Polytechnic Institution of Stockholm, and Professor Peter Tunner, of the Mining School of Leoben, in Austria, have lately published their views on the influence of hot blast in the blast furnace. The former contends that the great increase of temperature, and consequent economy of fuel, is chiefly attributable to the circumstance that the heat, which is carried by the blast into the furnace, as compared with that created by the combustion of the fuel, is introduced therein without increasing the volume of gases, as a greater bulk of expanded gases escaping at the furnace top will naturally carry a greater amount of heat with it. Seeing, however, that blast of only 350 to 450° F. will cause an economy of 25 per cent. of fuel against cold blast, Tunner means that besides the actual quantity of heat which the blast carries with it, its favorable influence must be looked for in the fact that it facilitates a rapid and complete combustion of the fuel, forming carbonic acid only, which again is not so easily to be reduced into carbonic oxide as Akerman and Bell seem to take for granted. While Akerman is of opinion that for producing white forge pig, the temperature of the blast should not be raised over about 500° F., i may be opposed to this, that in Styria white and mottled pig iron are constantly produced with hot blast of over 900° F., when the burden is only fluxed with somewhat more lime, the pressure of the blast diminished, and the crucible widened to some extent.

The Wasseralfingen system of horizontal and elliptical heating pipes utilizes the heat of the stove better than vertical pipes, as the cold air during its passage through the heating stove comes in contact with pipes of ever increasing temperature until it goes to the blast furnace; the absorption of heat being much more perfect when the pipes have a proper width in their greater diameter, so that the blast gets time to take up heat from their inner surface, when the stove is sufficiently high and wide to allow of a perfect mixture and combination of the air and the heating gases. It is evident when the cold blast enters the heating apparatus at its coldest, and leaves it at its hottest part, that its temperature will be always somewhat less that that of the pipes which it passes; that it consequently is in a still fit state for taking up heat from the latter. As cast-iron pipes will limit the degree of temperature which is obtainable, through their own fusibility, the Siemens regenerative principle has been also applied for heating blast. The Cowper apparatus seems to be more liable to become choked than that of Whitwell, which requires cleaning only once every three months. The latter was lately materially improved by enlarging considerably its first compartment; although its surface of contact was materially lessened, the temperature obtained was much greater, owing to the better combustion and the increased delay of the gases in the widened chamber. Though the regenerative system offers many advantages over the pipe system, it has not found much favor with Continental iron works, because it requires a large area, and is not so easily controlled and repaired as the latter.

Correspondence.

[Correspondents, in all cases, should sign their communications with their names and address in full—not necessarily for publication, but as a guarantee of good faith.—Ed.

A Correction.

111 Broadway, Room 95, New York,
March 10, 1873.

Mr. Editor: As the statement in your issue of 3rd instant, relating to the new works intended to be erected by the Pittsburgh Gas-Light Company, was not exactly correct, I beg to say that the new station will *not* be the largest in the United States, but it will be *one* of the largest, and of the following capacity:

The retort houses will contain one hundred and sixty benches of fives, or eight hundred retorts, 22 inches by 14 inches.

The other buildings will contain four multitubular condensers, four Livesey scrubbers, two exhausters, two engines and boilers, four sets of purifiers, and two station meters. There will also be erected three iron trussed telescopic holders, with wrought iron frames, each one hundred and thirty-six feet in diameter,

The contract for one of these holders has just been taken by Messrs. Morris, Tasker & Co., of Philadelphia, and the contract for the brick tanks by Messrs. Wilson & Gardner of Pittsburg.

Yours respectfully,
William Farmer.

The Hoosac Tunnel.—The Auditor General of Massachusetts has recently submitted to the Legislature an account of the financial condition of the Hoosac Tunnel and the Troy and Greenfield Railroad. While the tunnel was under the control of the Troy and Greenfield Railroad, the Commonwealth of Massachusetts gave subsidies to the company amounting to $970,680. After possession was taken by the Commonwealth, the expenditures to January 1, 1872, including interest on scrip, and deducting material sold rents and interest, amounted to $7,014,821. The payments during 1872 amounted to $842,530, so that on January 1st, 1873, the road and tunnel had cost $9,301,343, with a sinking fund of $1,233,505, which with its accumulations, will eventually have to be deducted in determining the final cost of the Hoosac Tunnel to the State. The contract with the Shanly's for the completion of the tunnel, calls for the sum of $4,594,268, on which, during the last three years, $2,266,224 have been paid, leaving $2,328,044 as the balance available for finishing the one-eighth of the tunnel not yet penetrated.—*Min. and RR. Jour.*

The Cost of a Fire.—Those who think that a fireproof system of building costs more than it comes to, and that a few dollars a year spent in insurance premiums are a sufficient safeguard against loss, will do well to read the report of the Massachusetts State Insurance Commissioner. The total loss in the Boston fire was 80 to 90 millions, of which 56,500,000 was covered by policies. Of the 187 insurance companies in Massachusetts, 147 suffered, 26 failed, and 5 outside companies are also in the hands of the receivers. The policy holders will do well if they receive 70 per cent. of the amount of their policies. This will give them less than $40,000,000, so that the owners bear one-half and the insurance people one-half the loss. It is quite certain that this forty millions would have sufficed to make the whole of the burned district fireproof. In fact, that sum, added to the present cost of the buildings, would probably make the whole city of Boston so near fireproof, as to render such an overpowering conflagration well nigh impossible.—*Engineer and Mining Journal.*

Light.—According to the theory generally recived at present, the whole universe is an immeasurable sea of highly attenuated matter, imperceptible to the senses, in which the heavenly bodies move with scarcely any impediment. The fluid, which is called ether, fills the whole of space—fills the intervals between the heavenly bodies, as well as the pores or interstices between the atoms of a substance. The smallest particles of this subtle matter are in constant vibratory motion; when this motion is communicated to the retina of the eye, it produces, if the impression on the nerves be sufficiently strong, a sensation which we call light. Every substance, therefore, which sets the ether in powerful vibration, is luminous; strong vibrations are perceived as intense light, and weak vibrations as faint light, both of them proceed from the luminous object at the extraordinary speed of 186,000 miles in a second, and they necessarily diminish in strength in proportion as they spread themselves over a greater space. Light is not, therefore, a separate substance, but only the vibration of a substance, which, according to its various forms of motion, generates light, heat, or electricity.

Passenger Cars and Oil Trains.—The recen railway accident on the Allegheny Valley Railroad ought to suggest a very necessary piece of legislation. The t ain included a number of oil-cars, with a single passenger-car. A broken rail threw the train from the track, and the passenger-car rolled over into the river, sinking in about five feet of water at a distance of fifteen feet from the bank. The petroleum from the wrecked oil-cars floated on the river, entered the windows of the passenger-car, and took fire from the stove. As a consequence, a number of people who otherwise would have sustained no injury, were burned to death. The extreme danger of attaching passenger cars to oil-trains is sufficiently evident without this horrible proof, but this recent accident ought to lead to a stringent law absolutely prohibiting petroleum from being carried on any train which carries passengers. It should also be noticed that had not the passenger-car been heated by a stove, the petroleum would not have taken fire. Is the stove never to be banished from our railways.—*Times, Feb.* 13.

PRICES OF FOREIGN AND DOMESTIC GAS COALS.

[Reported Expressly for this Journal.]

March 17, 1873.

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Ince Hall	$13 50	@	14 00
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Little Glace Bay—At Mines, 1 60 Gold			— —
Pennsylvania Coals.			
Penn Gas Coal—At Amooy	$6 75	@	0 00
Westmoreland	6 75	@	0 00
Shafton	6 00	@	0 00
Youghiogheny—At Baltimore	5 50	@	0 00
West Virginia Coals.			
Murphy Run	$6 75	@	0 00
Despard	6 75	@	0 00
West Fairmont	6 87½	@	7 00
American Gas Coal	6 62½	@	6 75
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Cloverhill of Virginia	5 25	@	5 50
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American Cannel Coals.			
Peytona of West Virginia	$14 00	@	14 50
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American Cannel	$10 00	@	10 00
Asphalts.			
Albertite of New Brunswick	$18 00	@	18 00
Ritchie Mineral of West Virginia	20 00	@	00 00
Trinidad Bitumen	— —	@	14 50

Experiment by Tyndall on Superheated Water.—The cause of steam boiler explosions is sometimes attributed to the fact that after water has been boiled for some time, it loses the air which was dissolved in it, and when this point is reached it suffers a peculiar modification. Water deprived of air does not vaporize slowly, but explosively throughout its whole mass. In order to obtain perfectly pure water, Faraday selected a clear piece of ice which he allowed to melt

[*For continuation see page* 100.]

THE AMERICAN

GAS-LIGHT JOURNAL

AND

Chemical Repertory,

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MONDAY, MARCH 17, 1873.

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CONDENSATION OF GAS.

It is well-known that coal distilled at the hea of 700 to 1000° Fahr. gives forth vapor, which, if condensed, yields volatile oils and other useful products. At a higher temperature gas is evolved, the most economical amount lying between 1500° and 2000°, so that the range of heat adapted for the production of oil, ends where that of gas-making begins. Mixed with the newly-generated gas, as it issues from the retorts, are certain volatile matters which must be gotten rid of before the gas is fit for public use. Two expedients have been resorted to, with a view to separate these impurities. First, the gas is cooled, and at once a portion of these vapors condenses, and, being only in mechanical combinations with the gas, they separate and are precipitated to the bottom of the vessel. This process is called *condensation*. Secondly, the remaining impurities, which, from chemical affinity, cling more obstinately to the gas, are removed by the use of chemical expedients—a process technically known as purification. It is with the former of these two processes that we are now chiefly concerned.

Probably no process connected with the art of gas-making requires from the engineer more ability and care than condensation; one reason for which is found in the fact that if coal-gas is cooled below a certain temperature, the carbonaceous vapors combined with it, the chief factors of its illuminating brilliancy, separate and are deposited. Even at a temperature of 45° this wasteful process sometimes goes on with great rapidity, and from this cause an inexperienced or ignorant engineer may, through his well-meant desire to secure thorough condensation, overshoot his mark, and seriously injure the quality of his gas; and it is worthy of note that by this malpractice the richest gases often suffer most and when cooled down to too low a temperature, lose the largest amount of their illuminating properties.

Another reason why the process of condensation is so important, and the necessity for watching and controlling the operation is so indispensable is, that mischief as surely results from too little condensation as from too much; for, except the gas be sufficiently cooled before entering the purifying apparatus, it carries with it the vapors and impurities which should have been previously cleansed away. The result is that the lime, and other chemical reagents employed, are not only prevented from acting properly, but more is required. Thus the expense of the operation is seriously increased. The chemical changes, essential to effective purification, and also disturbed. Hence imperfect condensation induces costly and imperfect purification, and the tarry vapors, being carried forward into the mains and pipes, are there condensed, and deposit themselves, choking up the valves and pipes, causing inconvenience to the consumers of gas, and impairing the action of the stop-cock and fittings. These tarry deposits are often precipitated at a considerable distance, and have been found in pipes a mile and-a-half from the gas-works, even after traversing mains and pipes of different diameters and different levels. Against these and similar incoveniences it behooves the engineer to guard by cooling his gas before it leaves the condensing apparatus, and is submitted to the chemical processes of purification.

Although the superintendence of gas-works is too often entrusted to men unqualified by experience, culture, chemical knowledge, and habits of patient observation, still there are numerous engineers in this country and in Europe, who, by unremitting toil and well-directed study make themselves acquainted with the wider range of scientific knowledge, indispensable for the successful conduct of a gas establishment. No error is more frequent or more fatal than to suppose that the apparently simple process of gas-making may be entrusted to ignorant, untrained men; for perhaps scarcely any other manufacturing operation can be named that requires more philosophic habit of thought, or will better repay the ingenuity, ability, and watchful care of the operator. In few profefsions is it more strictly true that "knowledge is power," and that skill insures success. We shall give a hearty welcome to communications of a practical nature, however brief, from managers of gas works, and from others interested in the manufacture of gas; for the results of experience and the obs ervations of intelligent minds are interesting in themselves, and cannot fail to augment the sum of human knowledge.

From our young engineers especially we would invite communications, begging them to remember that one test-fact faithfully recorded, or one experiment clearly represented, is worth more than whole volumes of vapid declamation or plausible argument. In the minds of those rising young men are thoughts, plans, methods which contain probably the germs of future discoveries.

GAS FOR HEATING.

Heating by gas is one of the most important of modern applications. The principle of heating is still in its infancy, and notwithstanding the progress of modern industry we are still compelled to warm ourselves as our ancestors did centuries ago. The fireplaces of Herculaneum were almost as our own. The Romans were ignorant of the laws of caloric, and knew as little of the conductibility and dilatability of air. The progress of physical science has but slightly benefitted modern construction—it is true generally, that they possess little more science than did the Romans of old. It has been calculated that the fire-places of the good old times, which could shelter an entire family under their respectable mantels, and receive four chimney sweepers in a row in their flues, that there was not obtained more than 1½ to 2 per cent of the heat developed by the combustion of the wood. The fireplaces of the present day do not give more than 8 to 10 per cent. of the heat developed—this result is the inevitable consequence of the mode of construction. It is of course necessary to allow the products of combustion to escape in order to avoid being smoked out, or poisoned by inhalation—but the same flue which gives passage to these products of combustion removes also the air as it becomes heated in the fireplace; therefore the only useful effect of our fireplaces consists in the heating of the air by their radiating power. The best means of obviating this difficulty is, to substitute heating by gas.

From an economical point of view, if we calculate the amount of heat which illuminating gas can produce burning in the open air, compared with that produced by the usual material of combustion, we obtain results little favorable to heating by gas. But if we take into consideration the heavy losses of heat during the perio l kindling and burning of the ordinary combustibles, the overheating of furnaces, flues, chimneys, etc., we will find a great economy, notwithstanding the high price of gas. The indirect

advantages are numerous—with gas one is spared the trouble of lighting and extinguishing a fire—it is sufficient to turn a stop-cock to put out a fire in the parlor, or to relight it in the bed-chamber. Thus, without expense or difficulty, heat can be transported from dining-room to parlor, from parlor to bed-room. With heating by gas we are relieved from that inevitable scourge, smoke. Thus without smoke fewer curtains are soiled, less paper blackened, less furniture covers to be cleaned, and that which is more important still, fewer lungs filled with smoke and dust.

The substitution of gas for the present means employed for heating would have an immense influence on the construction of houses and public edifices—it would dispense with these enormous conduits, which built against the walls, occupy so much valuable space in apartments, reach far above the roof, and are, for architects, a great embarrasment in the distribution of rooms, while they invariably disfigure the products of their skill.

Heating by gas has already become immensely developed in England, Russia, and in Paris; laboratories, kitchens, stoves, apartments are all heated by gas, and we trust the day is not far distant when it will be in general use in the United States.

AN EXCUSABLE ERROR.

In issue of Feb. 17, was copied an item, which was apparently an editorial from the *Manufacturer and Builder*, and was therefore credited to that Journal, and further, also to the gentleman whom we believe edits it, Dr. Van der Weyde.

A laconic (anonymous) note since received, asserts that the same "is word for word part of an editorial in the *Popular Science Monthly* for January." On an examination of our files of that Journal we find such to be the case. Our mistake is easily excusable, as we always desire to give credit where credit is due.

The item referred to is headed "Horace Greeley and Science."

GAS FIXTURES.

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OFFICE OF THE MANHATTAN GAS CO.,
IRVING PLACE, N. Y., Jan. 28, 1873.

J. W. BARTLETT, ESQ.,
869 Broadway, New York.

Dear Sir, In answer to your inquiries as to our experience in the use of your Patent Improved Torch and Key for lighting the public lamps, I beg to say that we have used them during the past three years, and find them satisfactory in every respect. We have by their use been able to dispense with one third of the number of men to light the lamps, besides saving the expense of ladders, matches, etc.

They do not interfere in the least with the proper care of the lamps, and we find the lamps to burn quite as well without the bottom glasses as with them. Sincerely yours,

CHARLES ROOME, President.

OFFICE OF THE NEW YORK GAS-LIGHT CO.,
155 and 157 WESTER ST., NEW YORK, Dec. 17, 1872.

J. W. BARTLETT, ESQ.

Dear Sir: In relation to your Patent Improved Torch and Key for lighting and extinguishing street lamps, I would say that we have had them in use since February 1870, and find them all that has been represented. They save a great deal of time and labor in lighting, and have given satisfaction to the company and to the men who light the lamps.

Respectfully yours,
THOS. K. LEES, Vice President.

P.S.—Our foreman informs me that the cost of making and fitting your Improved Key to the shanks of the ordinary gas cocks does not exceed five (5) cents each. T. K. LEES,
Vice President.

SPRINGFIELD MASS., Jan. 14, 1873.

MR. BARTLETT.

Dear Sir: I am greatly pleased with the Torch and Key for lighting our lamps. When I am out in the storm, I often think what an improvement it is over the old way. The difference in speed or rapidity in doing the work, seem to me as great as that between oxen and the locomotive.

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THE AUBURN GAS-LIGHT COMPANY (HAVING PUT in larger Works) offer for sale—Four Purifying Boxes, five feet square inside by two feet six inches deep for five Lime Trays six inch connections; one Jet Washer eight feet long—two feet six inches inside; one set six-inch Condensing Pipes and Boxes; six-inch Center Seal (wet).

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Patented in the United States and Great Britain, June 1867 first patent for this purpose in the United States (but not presented to the public until fully tested). Now in successful operation for six years, with most satisfactory results.

The many devices lately brought to the notice of the American public, to accomplish the same results are mostly old English contrivances tried and abandoned years ago, on account of the machinery, stuffing boxes, valves, levers, etc., necessary

But the extraordinary results obtained by the McIlhenny process, have induced some unprincipled persons to bring to the notice of the public, as *recent inventions of their own*, some of these old devices; their purpose seems to be simply to evade the patent.

This process is not only safe, simple and effective, but costs little to apply. The only machinery necessary is a one and a half inch stop cock, and a half inch stop cock to each bench No alteration in the old system is required. In fact, a Works operated with this process, can at any time be operated on the old pressure system, simply by closing the two stop cocks above mentioned. There is nothing to get out of order, nothing that requires special attention; no stuffing-boxes to pack and keep tight, no valves to keep clear of tar and pitch, no levers to lubricate, and no expense for a great amount of machinery.

The McIlhenny process challenges the world as regards yield and quality of gas.

For particulars apply to GEO. A. McILHENNY, Engineer of the Washington Gas-Light Co., Washington, D. C., or to WILLIAM YORKE, Engineer of the Portland Gas-Light Co., Portland, Me., who will take pleasure in corresponding with any one interested. 307-1y

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with exclusion of air, and thus obtained water devoid of air, with which to try the experiment indicated above. Tyndall has modified this by taking two test glasses covered with a bell jar; in one he puts a small piece of ice, which he covers with a layer of oil; in the other undistilled water, also covered with oil. Both are brought to the boiling point; as soon as the one free of air reaches the degree of vaporizatien it explodes, dashing the oil over the bell jar. The water in the second test tube boils away quietly in the usual manner.—*Jour. Applied Chemistry.*

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AMERICAN

GAS SCREEN MAN'F'G COMPANY.

TO GAS-LIGHT COMPANIES.

Your attention is respectfully called to the GAS SCREEN now being manufactured by the American Gas Screen Manufacturing Company, under the patents granted to E. DUFFEE, and are pleased to submit the following points of their excellence and superiority over all other screens now in use.

The Screen is made with an oak frame, interlaced with split rattan, drawn through holes at regular intervals in the Frame and cross-pieces, the edges of the frame being grooved to prevent abrasion.

The advantages of the screen are:

1st. The large purifying surface, the construction of the Screen giving over three-fourths of the surface for the gas to penetrate the lime.

2d. On account of the free passage of the gas through the Screen the pressure is reduced, thereby preventing the accumulating of carbon on the retorts.

3d. The saving of lime and labor, as the Screens are not liable to clog, and are easily cleaned.

4te Their cheapness and simplicity of construction.

5th. Their DURABILITY—they can be used longer than any other now used.

Testimonials.

PROVIDENCE, RHODE ISLAND, March 21st, 1872

E. DUFFEE, Esq., Agent, etc.

Dear Sir: The Trays manufactured by you for our West Station were put in use in September last, and have *given perfect satisfaction.*

The frames are well put together, and I see no reason why they will not last for a long time. The *very large amount of open space* in these Trays gives the gas an easy passage, and brings it into contact with the lime much better than when the space is so contracted, as is the case in most of the other Trays in use.

The pressure thrown upon the retorts by contracted passages is very great and were gauges used more frequently than they now are in many gas-works, this facat of having *open Trays* would become more apparent to mangers of gas works. The digerence in pressure at this station in passing the gas through your purifiers, is two-tenths (2-10) inches.

The amount of gas purified, per bushel of lime used to this date, 18 six thousand five hundred and fifty six (6,556) cubic feet.

Respectfully yonrs,
JAMES H. ARMINGTON, Supt.

BOSTON GAS-LIGHT CO., Dec. 1871.

Dear Sir: In answer to your inquiry how we like your Patent Tray for dry gas purifiers, I take pleasure in saying we have used them exclusive of all others, for the last three years, and think them far ahead of any yet offered. The surface being nearly three times that of any other Tray, and their lightness and durability perfectly satisfactory.

Yours respedtfully,
A. M. GILES.

EDWARD DUFFEE, Esq.

EAST BOSTON, JUNE 15, 1871.

Gentlemen: We have used your Screens some five years. They give perfect satisfaction.

I consider them *by far the best Screen* for Dry Lime Purifiers I have seen. Yours truly, A. M. NORTON, Supt.

CHELSEA, May 1, 1871.

Mr. E. DUFFEE.

We are using your Purifying Trays, and find them to be the *best of any* that I have used, and will *purify more gas with less pressure* than any tray that I know. I can fully recommend them, after four years' trial, to any Gas Superintendent with perfect safety, as the *cheapest and best Tray made.*

Yours truly, JOHN ANDREW, Sup't.

DORCHESTER, March 3. 1870.

Mr. E. DUFFEE.

Dear Sir: We have had your Gas Trays in constant use for almost one year and six months, and find them superior to any others we have ever used, both in point of economy and efficiency. Truly yours, W. B. BROOKS,
Agent Dorchester Gas-Light Co.

JAMAICA PLAINS, MASS., June 21, 1871.

EDWARD DUFFEE, Esq.

Dear Sir; The Trays ordered by this company three years ago, are getting somewhat worn. I wish to say here that I consider your Trays to be superior to any yet invented, therefore please make us another set at the price named, to be like the sample shown in every way, and oblige Yours truly
JAMES F. ROGERS,
Sup't Jamaica Plains Gas-Light Co.

BROOKLINE, June 11, 1871.

E. DUFFEE, Esq.

Dear Sir: You will please make a set of Gas Trays for this company as soon as convenient, at price named. In regard to the merits of the Tray, after having them in constant use for over two years, I will say that I consider them *superior to any Tray* manufactured in this country. Respectfully yours,
H. A. ALLYN,
Sup't Brookline Gas-Light Co.

BANGOR, August 2, 1870.

EDWARD DUFFEE, Esq.

Dear Sir: Yours of the 20th ult. is received. In regard to your Gas Trays, I take pleasure in saying that they have been in use over two years, and have given perfect satisfaction and they are in good order at the present time; should have no hesitation in recommending them, believing they are the most durable and easiest kept in order of any with which I am acquainted. Respectfully yours,
W. H. PERRY, Sup't.

OFFICE OF THE SPRINGFIELD GAS-LIGHT CO.
SPRINGFIELD, MASS., Oct. 10, 1871.

Mr. WARD,
President Hartford Gas-Light Co.

Dear Sir: I have been using Gas Screens made by the American Gas Screen Company, for nearly a year, and find them superior in every way to the wooden Screens made and formerly used by the Springfield Gas-Light Co. I can purify more gas with the same quantity of lime, there being more surface to the Screens; and I consider them more durable, and recommend them to your consideration.

Yours with great respect,
GEORGE DWIGHT.

ROXBURY, June 14, 1872.

EDW. DUFFEE, Esq.

Dear Sir: In answer to your inquiry regarding your Patent Gas Screens, I am happy to be able to say, that after nearly three years constant use we are perfectly satisfied with them being able to purify over fifty pet cent. more gas with them, than with any other Screen we have used,

Yours respectfully,
THOMAS J. PISHOU.

OFFICE DETROIT GAS-LIGHT CO.,
DETROIT, MICH., April 22, 1872.

AMERICAN GAS SCREEN MANUFACTURING CO., HAVERHILL.

Gentlemen: The Screens bought of you work far better than any we have ever used. As a proof, we have with the same quantity of lime purified *twenty per cent.* more gas with your Screens than with any others, and the work well done. The workmen are also better pleased with them—they being light and handy to work. They also relieve the pressure very much upon the retorts, and I cheerfully give yau my experience. Yours truly,
P. E. DEMILL, Secretary.

We give a list of some Gas-Light Companies using them.

Providence, R. I. Gas-Light Co., Boston, Mass. Gas-Light Co.: East Boston, Mass., Gas-Light Co.; South Boston, Mass., Gas-Light Co.; Springfield, Mass., Gas-Light Co.; New Bedford, Mass., Gas-Light Co.; Manchester, N. H., Gas-Light Co.; Reading, Penn., Gas-Light Co.; Biddeford, Me., Gas-Light Co.; Hartford, Conn., Gas-Light Co.; New Haven, Conn., Gas-Light Co.; New Orleans, La., Gas-Light Co.; Savannah, Ga., Gas-Light Co.; Charleston, S. C., Gas-Light Co.; Trenton, N. J., Gas-Light Co.; Charlestown, Mass., Gas-Light Co.; Dorchester, Mass., Gas-Light Co.; Chelsea, Mass., Gas-Light Co.; Baltimore, Md., Gas-Light Co.; Manhattan, N. Y., Gas-Light Co.; Cincinnati, Ohio.; Gas-Light Co.: San Francisco, Cal., Gas-Light Co.: Albany, N. Y., Gas-Light Co.; Sacramento, Cal.; St. Joseph, Mo., Gas-Light Co.; Leavenworth, Kansas, Gas-Light Co.; Macon, Ga., Gas-Light Co.; Roxbury, Mass., Gas-Light Co.: Lansinghburg, N. Y., Gas-Light Co.; Bridgeport, Conn., Gas-Light Co.; Stamford, Conn., Gas-Light Co.; Poughkeepsie, N. Y., Gas-Light Co; Scranton, Penn., Gas-Light Co.; Lewiston, Me., Gas-Light Co., and one hundred others.

Address **A. P. JAQUES, Treas.,**
Amer. Gas Screen Man'f'g Co., Haverhill, Mass

DENNIS LONG & CO.,

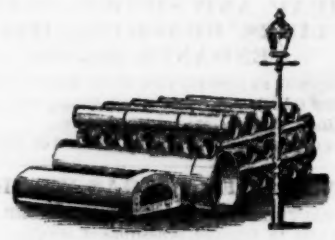
Union Pipe Works.

Louisville Pipe Foundry,

AND

Union Foundry and Machine Shops,

LOUISVILLE, KY.



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All Pipe cast vertically in dry sand.

2 inch Pipes in 8 feet lengths. 3 inch to 60 inch cast in 12 feet lengths.

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GAS-HOLDERS.

And every description of work necessary for Gas or Water Companies.

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ARCHITECT AND GENERAL GAS ENGINEER,

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WILLIAM FARMER may be consulted upon all matters connected with the construction of GAS WORKS and other buildings. Will furnish General and Detail Drawings, Specifications and Estimates for Gas Works of any capacity, Retort Settings, Condensers, Washers, Exhausters, Purifiers, Holders, Coal Hoisting Apparatus, Iron Roofs, and every description of Machinery required in the Manufacturing of Gas.

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Pumps for Water, &c., &c.

REFERENCES:

CHAS. ROOME, President Manhattan Gas-Light Company, N. Y.
SAMUEL DOWN, President American Meter Company, N. Y.
C. VANDERVOORT SMITH, Engineer Manhattan Gas-Light Company, N. Y.
CHARLES MOWTON, Engineer New York Gas-Light Company, N. Y.
SAMUEL P. PARHAM, Engineer Mutual Gas-Light Company, N. Y.
Prof. HENRY WURTZ, Editor AMERICAN GAS-LIGHT JOURNAL.
HENRY J. DAVISON, Engineer, 77 Liberty Street, N. Y.
HERRING & FLOYD, Oregon Iron Foundry, 738 Greenwich Street, N. Y.
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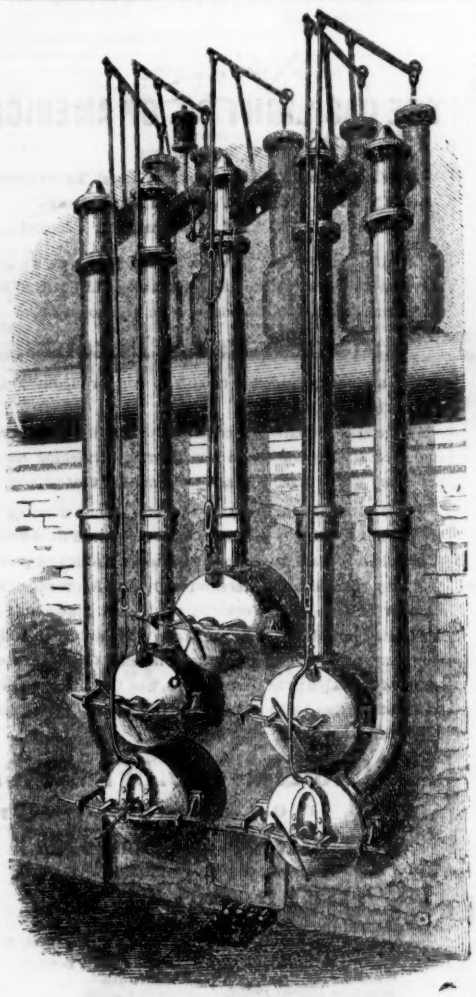
JOHN HARRISON, Engineer People's Gas-Light Company, Baltimore, Md.
CHARLES FABEN, Superintendent and Engineer Toledo Gas-Light Co., Toledo, O.
PETER F. BURTIS, Supt. and Engineer, Chicago Gas-Light Co., Chicago, Ill.
JAMES R. SMEDBERG, Consulting Engineer, San Francisco Gas-Light Co., Cal. [254-



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The Seal closes automatically, when the retort-lid is removed, and is broken by replacing the lid. No mistake can possibly be made. The rods are adjustable in a moment to any contingency. The new attachments are adaptable to any Works. Cost only that of rough castings. No lute used, and no leakage at lids. Half the number of lids only needed. Capacity of mains greatly increased. In new Works no mains. No carbon in retorts, seldom in stand-pipes. Addre

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OHIO GAS CANNEL,
From the Sterling Colliery.

I am now prepared to place in the market, through my agencies as below, a regular and unlimited supply of this valuable Cannel, for gas purposes. A recent analysis, by Prof. WURTZ, Editor of this Journal, at the Laboratories of the NEW YORK GAS-LIGHT COMPANY, gave 47½ per cent of Volatile Matter and 45 bushels to the ton of a fair quality of coke. The yield of gas was at the rate of 9,500 feet per ton of about 27 candle power. It is not highly sulphurous, can be purified by Lime, and the ash from the coke does not clinker.

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Agents for G. W. EDGE'S PROCESS for removing Carbon from Retorts.

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CAUTION.

SEVERAL CONTRIVANCES HAVING BEEN DEVISED for the purpose of dispensing with the dip-pipe seal, by means of a valve, or cut-off, between the retort and the hydraulic main, in gas works, since this method of making gas was introduced by the AMERICAN COAL GAS LIGHT IMPROVEMENT COMPANY, all of which are infringements upon Letters Patent, numbered 95,459—116,450—and 119,135, owned by said Company. All Gas-Light Companies are cautioned against the use, without license or authority from the undersigned, of said devices.

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5 PEMBERTON SQUARE, BOSTON. 41 PINE STREET, N. Y

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We are now prepared to contract for this class of Castings under the most favorable terms.

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GAS-HOLDERS.
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Used in the Erection of Gas and Coal Oil Works.

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PARTIES WRITING TO THE UNDERSIGNED ON GAS Matters, will please address J. B. CHICHESTER,
Engineer, Bayonne and Greenville Gas-Light Co.
Bergen Point N. J.

302-6m

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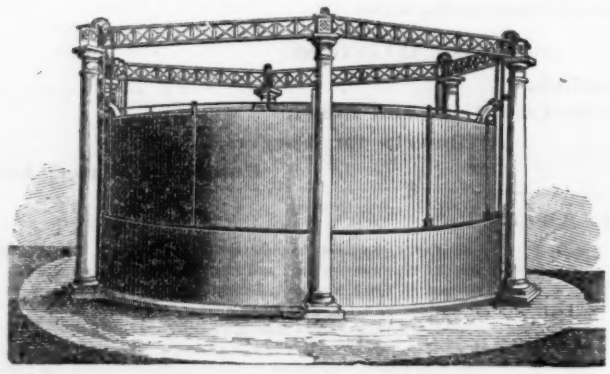

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Particular Attention paid o Alterations and Repairs.

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Benjamin Acton, Salem Gas Co., N. J.
D. H. Smith, Watkins Gas Co., Watkins, N. Y.
W. F. Warner, Oswego Gas Co., N. Y.
E. Wilcox, Joliet Gas Co., Ill.
Messrs. Woodbury, Walter & Potter, Kalamazoo Gas Co., Michigan.
H. H. Fish, Utica Gas Co., N. Y.
W. J. Ball, Terre Haute, Indiana.

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GLOUCESTER CITY, NEW JERSEY.

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FURNISHED WITH LONG OR D HANDLES

Perfect in their operation. strong, and from their great dur vastly more economical than any stitute. Refer to all the princip Companies in the country, w knowledge them as the "ne plus of Coke Screening Shovels.

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Sole Agent.
No. 96 Maiden Lane, N. Y.

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Gas Companies, and all parties using Screening Shovels are cautioned against the purchasing (or manufacturing) of any other than myself, or my agents, COKE SCREENING SHOVELS, made either in whole, or in part, of **Malleable Iron,** as such is decided to be an infringement of Butler's Patent of June 4, 1872. O. R. BUTLER,
96 Maiden Lane, N. Y.

OFFICE OF

THE GAS-LIGHT CO. OF AMERICA,

C. K. GARRISON, President.
E. W. McGINNIS, Secretary and Treasurer.
JOHN P. KENNEDY, Chief Engineer.
LEONARD D. GALE, Consulting Chemist.

Gentlemen: We beg leave to inform you, that we have purchased the Patent process for making ILLUMINATING GAS from PETROLEUM and its products, known as the

Gale and Rand Patents,

and we are now prepared to treat with you for the use of said process by your Company.

We are also prepared to contract for putting said process into successful operation in your works, furnishing all the necessary plans, materials, and workmen for that purpose.

We do not deem it necessary to enter upon a detailed description, here, of the processes above referred to, deeming it sufficient to state, to secure your interest and investigation, that they have been in successful operation, for months, in a number of Gas-Light Works in the United States, and are now being introduced in the works of the Mutual Gas-Light Company, of New York City; the Citizens' Gas-Light Company, of Brooklyn; the New Orleans, San Francisco, and very many other Gas-Light Companies throughout the country.

For full particulars, address

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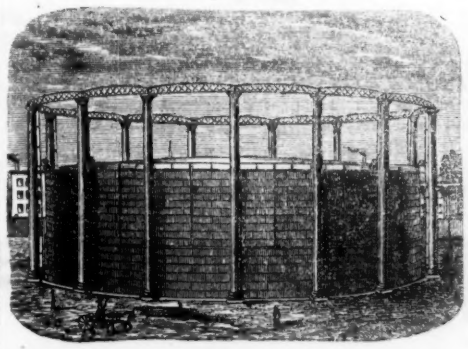

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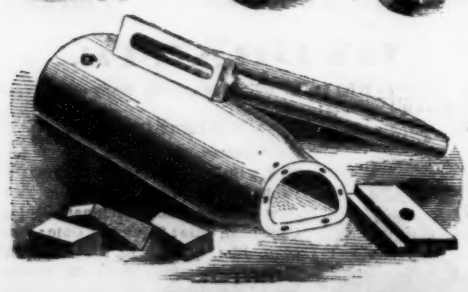

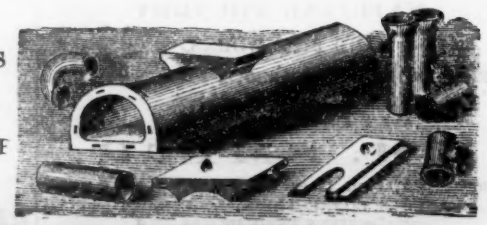

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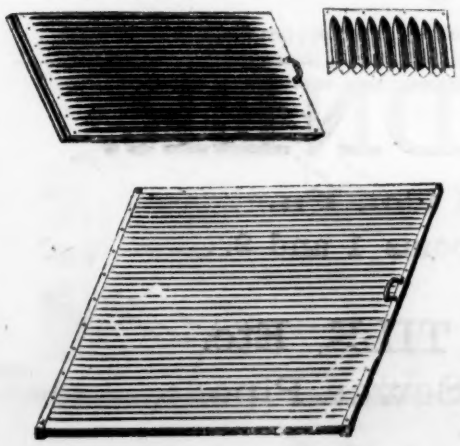

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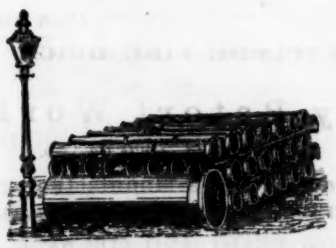

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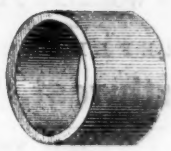

FIG. 2.

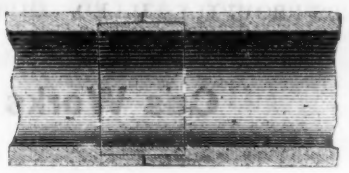

FIG. 3.

A—Cylinder of Wood. B—Band of Iron. C—Coating of Hydraulic or Asphaltum Cement.

FIG. 2.—Thimble for Connection. FIG. 3—Horizontal Section and Connection.

Above is a cut of the

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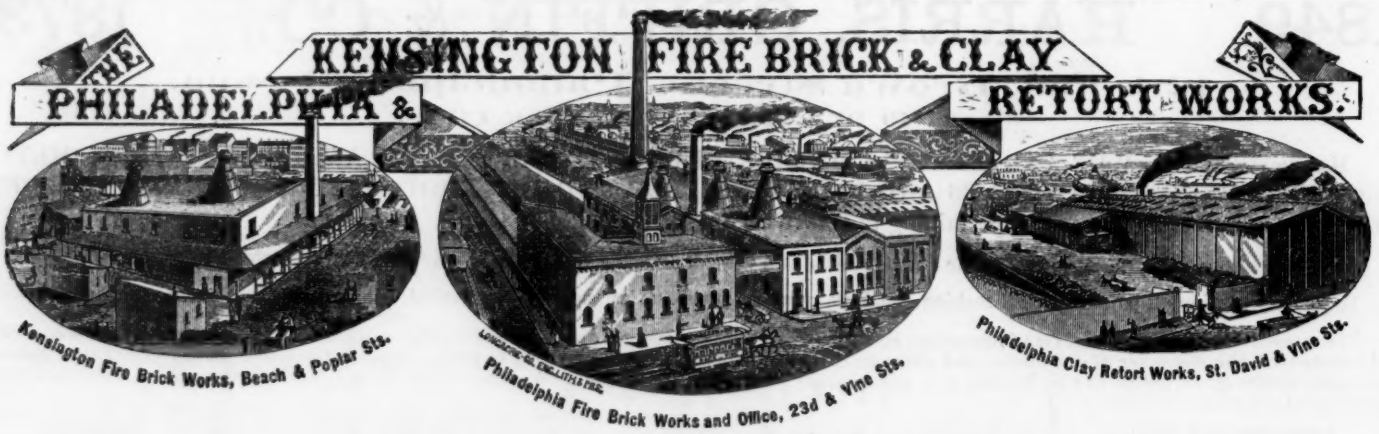
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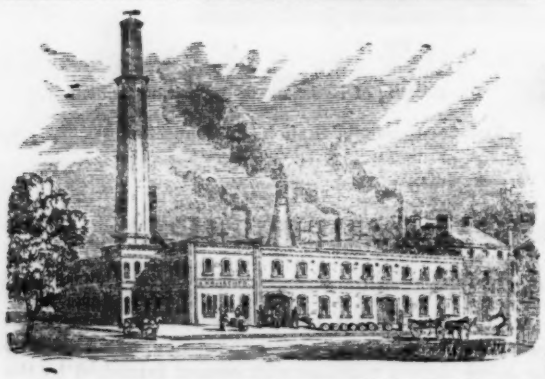

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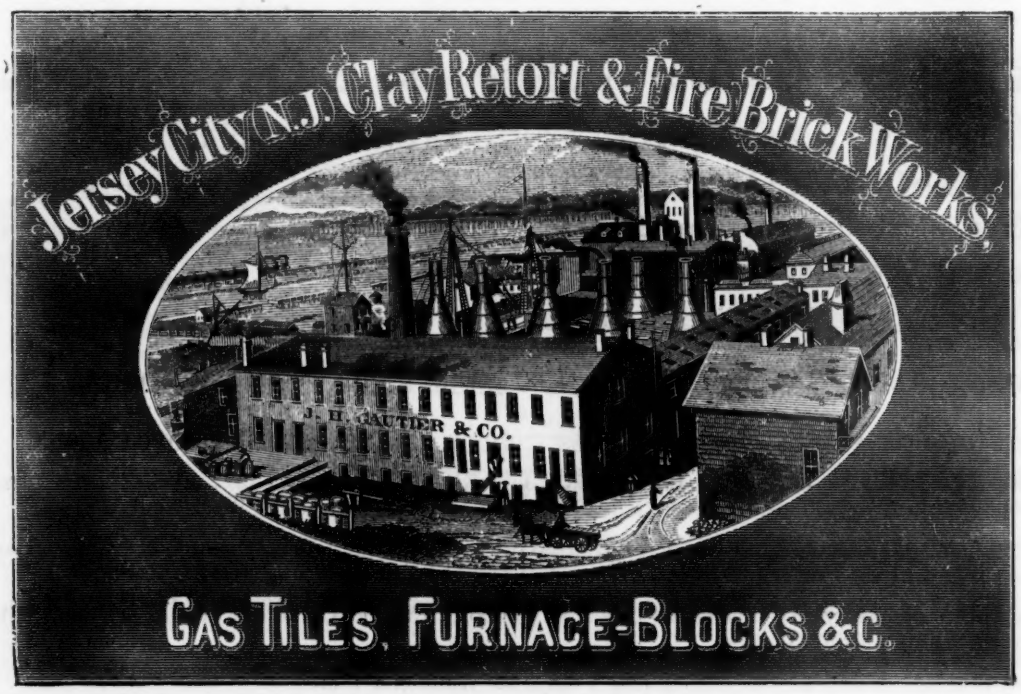

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The Mackenzie Patent Gas Exhauster

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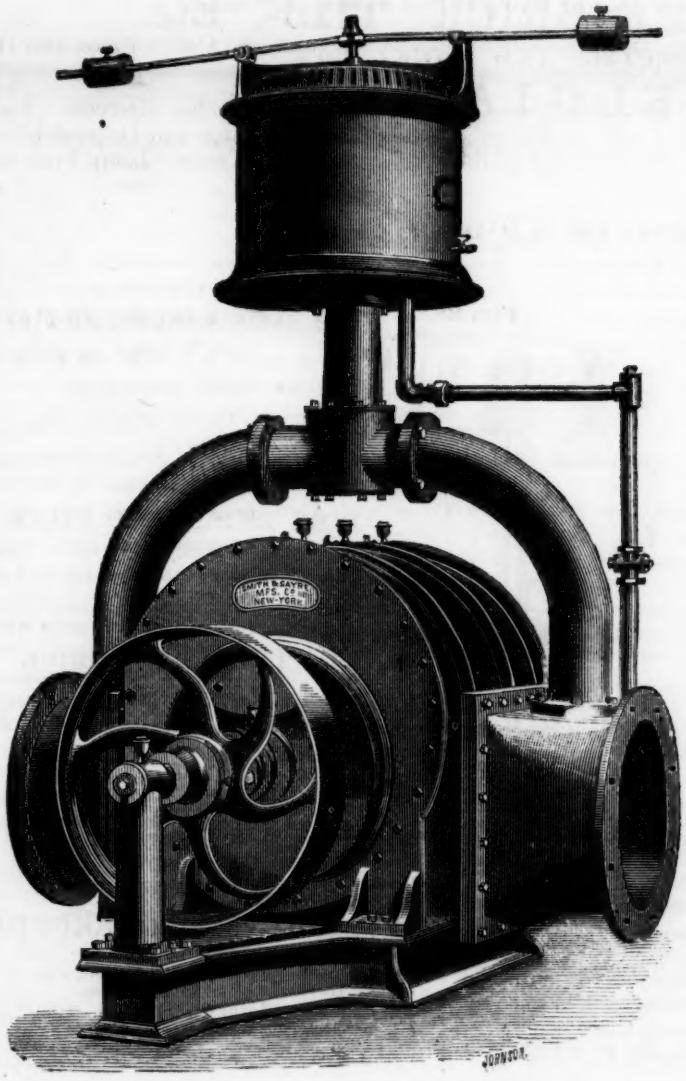

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Fig. 2 represents a section through.

The construction of the Valve is such that one Purifier is always shut off for cleaning or repairing.

The claim in this improvement is the concentric inlet and outlet, drip pipes, rotary valve, and the covered radial joints.

Fig. 1.

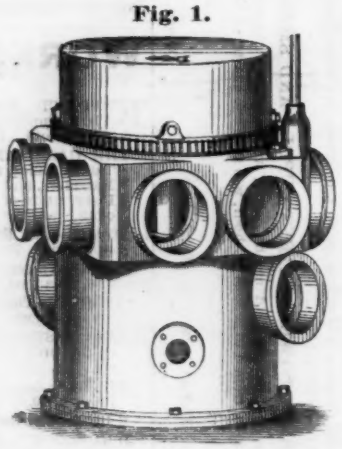
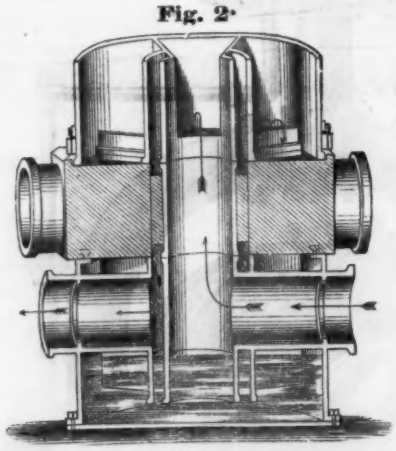


Fig. 2.



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Westchester Gas-Light Company, N. Y., 10 in.
St. Paul Gas-Light Company, Minn., 10 in.
Schenectady Gas Light Company, N. Y., 10 in.
Rahway Gas-Light Company, N. J., 8 in.
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Altoona Gas-Light Company, Pa., 8 in.
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East Newark Gas-Light Company, N. J., 6 in.
Cumberland Gas-Light Company, Mo,, 8 in.
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